INTERNATIONAL STANDARD ISO 3994

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Plastics products — Hose of polymer reinforced thermoplastics for suction and discharge

Produits en plastiques — Tuyaux thermoplastiques à renforcement polymérique pour aspiration et refoulement

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3994 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*, and was circulated to the member bodies in February 1976.

It has been approved by the member bodies of the following countries :

Australia	Greece	Romania
Belgium	Hungary	Spain
Brazil	India	Sweden
Canada	Italy	Turkey
Czechoslovakia	Mexico	United Kingdom
Egypt, Arab Rep. of	Netherlands	U.S.A.
France	Poland	U.S.S.R.
Germany	Portugal	

No member body expressed disapproval of the document.

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Plastics products — Hose of polymer reinforced thermoplastics for suction and discharge

0 INTRODUCTION

This International Standard has been prepared to provide minimum acceptable requirements for the satisfactory performance of polymer reinforced thermoplastics hose for suction and discharge applications, conveying water, aqueous chemical solutions and abrasive solids and slurries.

If there is a special requirement for resistance to deleterious chemicals this shall be a matter for agreement between the supplier and the purchaser.

The list of nominal bores given in tables 1 and 2 is not intended to be restrictive or to preclude the manufacture of other sizes than those of the R 10 series of preferred numbers (the basis of the tables) and which may be the subject of individual national standards.

When a suitable and agreed ageing test is available an ageing requirement will be added to this International Standard.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the requirements for three types of polymer reinforced thermoplastics hose for suction and discharge applications for use in the temperature range − 10 to + 55 °C, as follows :

— **Type 1** : light service;

— **Type 2** : normal service;

— **Type 3** : heavy service.

The types of hose covered in this International Standard are not intended for use with flammable and combustible materials or with aromatic solvents.

2 REFERENCES

ISO 176, *Plastics — Determination of loss of plasticizers — Activated carbon method.*

ISO 1307, *Rubber hose — Bore sizes, tolerances on length, and test pressures.*

ISO 1402, *Rubber hose — Hydrostatic testing.*

ISO 1746, *Rubber hose — Bending test.*

3 MATERIALS AND CONSTRUCTION

The hose shall be as uniform as commercially practicable in colour, opacity and other physical properties. It shall consist of a flexible thermoplastics material supported in its mass by a helix of polymer material of a similar molecular structure. The reinforcing and flexible components of the wall shall be fused and free from visible cracks, porosity, foreign inclusions or other defects such as are liable to cause failure of the hose in service.

4 DIMENSIONS AND TOLERANCES

4.1 Bore

The bore of the hose shall meet the requirements of tables 1 and 2, which are in accordance with ISO 1307.

TABLE 1 — **Nominal bore and tolerance — Types 1 and 2**

Dimensions in millimetres

Nominal bore	Tolerance
12,5	± 0,75
16	± 0,75
20	± 0,75
25	± 1,25
31,5	± 1,25
40	± 1,50
50	± 1,50
63	± 1,50
80	± 2,00
100	± 2,00
125	± 2,00
160	± 2,00

TABLE 2 — **Nominal bore and tolerance — Type 3**

Dimensions in millimetres

Nominal bore	Tolerance
25	± 1,25
31,5	± 1,25
40	± 1,50
50	± 1,50
63	± 1,50
80	± 2,00
100	± 2,00
125	± 2,00
160	± 2,00
200	± 2,00
250	± 3,00
315	± 3,00

NOTE — Hoses of other nominal bore, for preference using the R 20 series of preferred numbers, may be the subject of an agreement between the interested parties or detailed in national standards. The tolerance should be as for the next larger bore size given in table 1 or 2.

4.2 Length

The tolerances on cut lengths shall be in accordance with ISO 1307.

5 PHYSICAL TESTS ON FINISHED HOSE

5.1 Hydrostatic test (23 ± 2 °C)

The hose when tested by the method specified in ISO 1402 at 23 ± 2 °C shall meet the requirements of table 3.

At proof pressure (i.e. 50 % of minimum burst pressure) the hose should be examined for evidence of leakage, cracking, abrupt distortion indicating irregularity in materials or manufacture, or other signs of failure.

The values in table 3 are based on the following safety ratios :

- **type 1** : 2,5 : 1
- **type 2** : 3,15 : 1
- **type 3** : 4 : 1

5.2 Hydrostatic test (55 ± 2 °C)

The hose when tested by the method specified in ISO 1402 at 55 ± 2 °C shall meet the requirements of table 4.

The values in table 4 are based on the following safety ratios :

- **type 1** : 2,5 : 1
- **type 2** : 3,15 : 1
- **type 3** : 4 : 1

5.3 Pulsating pressure test requirements

When tested in accordance with the method specified in annex A the hose shall withstand a minimum of 10 000 cycles. The test piece shall be considered to have failed if it develops a leak or rupture. In the event of a failure within one diameter from either coupling the test shall be disregarded and a further test piece tested. The maximum pressure of the test cycle (figure 1) shall be 120 % of design working pressure.

5.4 Vacuum test requirements

When tested in accordance with the method specified in annex B using the absolute pressure indicated in table 5, the hose shall not fail due to collapse or fracture at a point which is more than one diameter distance from the coupling. In the event of failure closer to the coupling the test shall be disregarded and a further test piece tested.

5.5 Reinforcement fracture test requirements

When tested in accordance with the method specified in annex C the polymer reinforcement shall be capable of reverse bending without cracking after 336 h extended over the appropriate size extension piece listed in table 6.

NOTE — This period is intended as a control test. For a type test a period of four months should be used.

5.6 *Minimum bend radius requirements*

When tested in accordance with ISO 1746 using a minimum radius of curvature (c) of five times the nominal bore, in the cases of type 1 and type 2 hoses, and eight times the nominal bore in the case of type 3 hose, the hose shall not crack.

5.7 Cold bend radius requirements

When tested at −10 ± 2 °C in accordance with the requirements of ISO 1746 after conditioning for 5 h at that temperature and using a minimum radius of curvature (c) of four times the value in accordance with 5.6, the hose shall not crack.

TABLE 3 — **Hydrostatic tests at 23 ± 2 °C**

Size group (nominal bore) mm	Design working pressure, all types MPa (bar)	Minimum bursting pressure MPa (bar)		
		type 1	type 2	type 3
12,5 up to and including 25	0,7 (7,0)	1,7 (17)	2,2 (22)	2,8 (28)
31,5 up to and including 63	0,5 (5,0)	1,25 (12,5)	1,6 (16)	2,0 (20)
80	0,4 (4,0)	1,0 (10)	1,25 (12,5)	1,6 (16)
100 up to and including 125	0,3 (3,0)	0,75 (7,5)	0,95 (9,5)	1,2 (12)
160 up to and including 250	0,25 (2,5)	0,6 (6,0)	0,8 (8)	1,0 (10)
315	0,2 (2,0)	–	–	0,8 (8)

TABLE 4 — **Hydrostatic test at 55 ± 2 °C**

Size group (nominal bore) mm	Design working pressure, all types MPa (bar)	Minimum bursting pressure MPa (bar)		
		type 1	type 2	type 3
12,5 up to and including 25	0,20 (2,0)	0,50 (5)	0,65 (6,5)	0,80 (8)
31,5 up to and including 63	0,15 (1,5)	0,40 (4)	0,45 (4,5)	0,60 (6)
80	0,13 (1,3)	0,30 (3)	0,40 (4)	0,50 (5)
100 up to and including 125	0,10 (1,0)	0,25 (2,5)	0,30 (3)	0,40 (4)
160 up to and including 250	0,08 (0,8)	0,20 (2)	0,25 (2,5)	0,30 (3)
315	0,06 (0,6)	–	–	0,25 (2,5)

TABLE 5 — **Pressures for the vacuum test**

Nominal bore mm	Types 1 and 2 hose, absolute pressure mbar (kPa)	Type 3 hose, absolute pressure mbar (kPa)
12,5 up to and including 160	350 (35)	–
25 up to and including 315	–	200 (20)

TABLE 6 — **Extension pieces for fracture test**

Dimensions in millimetres

Nominal bore	Block width
12,5	10
16	12
20	16
25	19
31,5	23
40	27
50	31
63	34
80	38
100	44
125	49
160	53
200	59
250	66
315	75

5.8 Loss in mass on heating

The flexible thermoplastics material used in the construction shall, when tested in accordance with ISO 176 (method B), have a loss in mass not greater than 4 %.

6 MARKING

The hose may be marked using a contrasting indelible ink with the following information or as agreed between the purchaser and the supplier :

a) manufacturer's name or trade mark;

b) number of this International Standard;

c) hose type;

d) hose nominal bore;

e) year of manufacture (last two digits).

Characters should be at least 5 mm high.

ANNEX A

PRESSURE IMPULSE TEST

A.1 APPARATUS

A circuit capable of applying an internal hydraulic pressure which can be released at a predetermined level, delayed by a fixed period of time and the cycle repeated. The cycle shall comply with the pressure/time requirements of figure 1.

A suitable circuit is shown in figure 2.

A.2 TEST FLUID

The test fluid shall be water, which may be suitably dyed. Other fluids may be used by agreement between the customer and the supplier.

A.3 TEST PIECES

A minimum of three test pieces of hose with end fittings shall be tested. The clear distance between fittings shall be at least 5 times the nominal bore.

A.4 CONDITIONING

No test shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at 23 ± 2 °C for at least 3 h before testing which may be part of the 24 h.

A.5 PROCEDURE

Connect the test piece in the straight condition to the apparatus and ensure that the temperature of both the test fluid and the ambient conditions is 23 ± 2 °C. Purge all air from the test piece. Apply 10 000 impulse cycles.

A.6 TEST REPORT

The test report shall include the following :

— number of cycles to failure if less than 10 000;

— position and mode of failure for each test piece;

— test fluid and dye used, if applicable.

ANNEX B

VACUUM TEST

B.1 APPARATUS

A **vacuum pump** capable of achieving an absolute pressure of 200 mbar (20 kPa); the evacuation rate should be uniform and be such that the vacuum is achieved in less than 1 min.

B.2 TEST PIECE

A minimum test length clear of the fittings of five times the bore of the test hose shall be used.

B.3 CONDITIONING

No test shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at 23 ± 2 °C for at least 3 h, before testing, which may be part of the 24 h.

B.4 PROCEDURE

Attach end fittings to the test piece without causing damage to the hose.

Ensure that the ambient temperature is 23 ± 2 °C. Apply the appropriate vacuum listed in table 5 within 1 min. Maintain for 10 min.

B.5 TEST REPORT

The test report shall state either no failure or the position and mode of failure for each test piece, as applicable.

ANNEX C

REINFORCEMENT FRACTURE TEST

C.1 APPARATUS

Lengths of hardwood or metal of rectangular section, with one cross-section dimension of the appropriate value given in table 6.

C.2 TEST PIECES

The test piece shall contain three helices of reinforcement. This shall be split with a clean cut along its length. Three test pieces shall be tested.

C.3 CONDITIONING

No test shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at 23 ± 2 °C for at least 3 h before testing, which may be part of the 24 h.

C.4 PROCEDURE

Open up the test piece and place it on the block extension appropriate to its bore (see table 6) as indicated in figure 3.

Leave in this condition for either 336 h (for a control test) or 4 months (for a type test) as appropriate.

Reverse bend the test piece until the outside surfaces touch, and examine for cracking of the helix (see figure 3).

C.5 TEST REPORT

The test report shall state either no failure or the position and mode of failure for each test piece, as applicable.

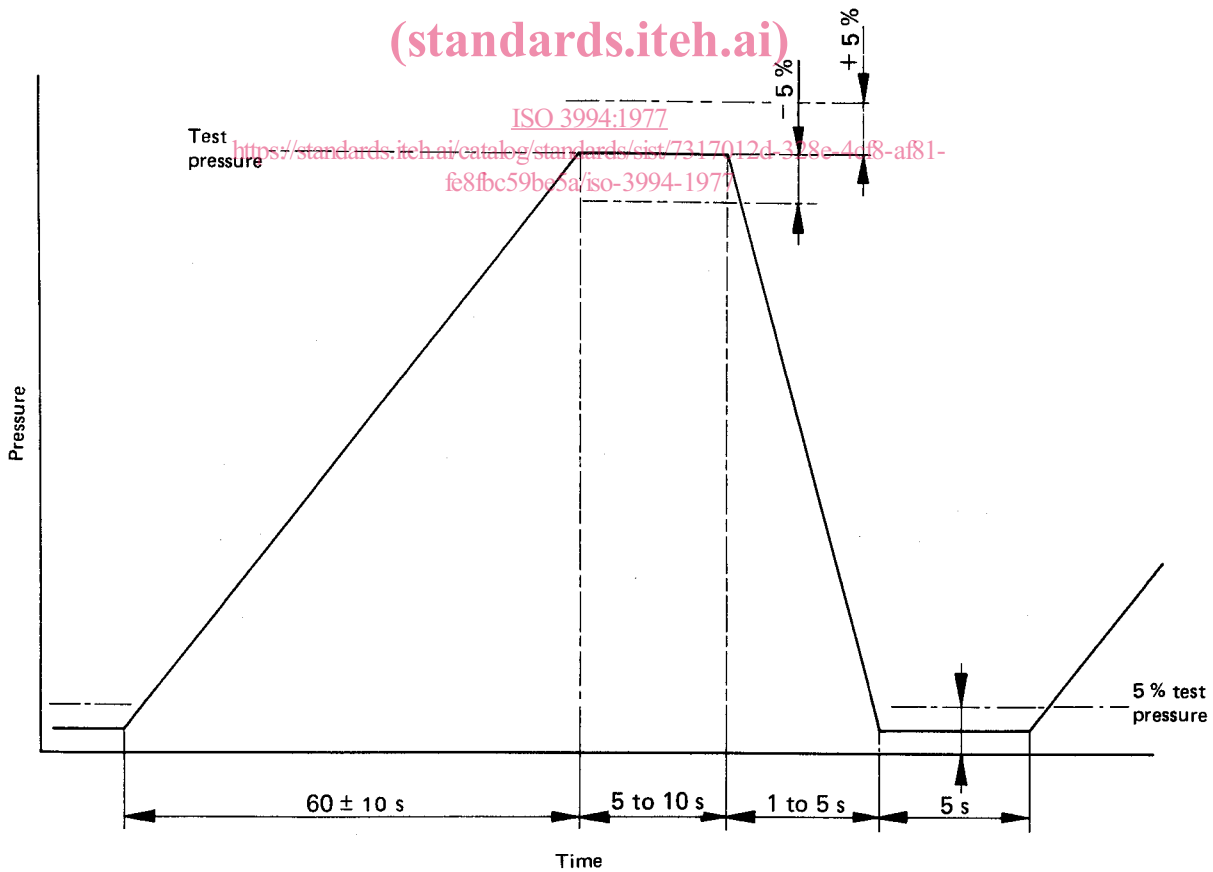

FIGURE 1 — **Pressure impulse cycle**

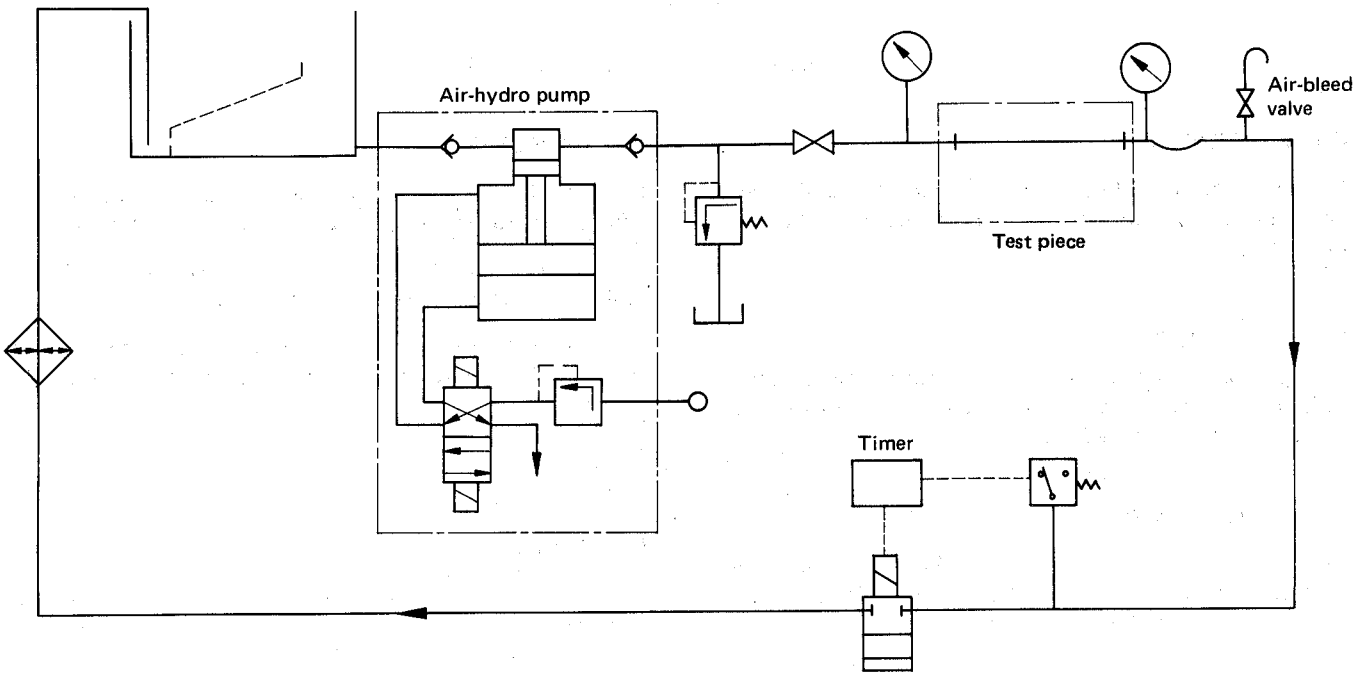

FIGURE 2 – **Suitable impulse test circuit**

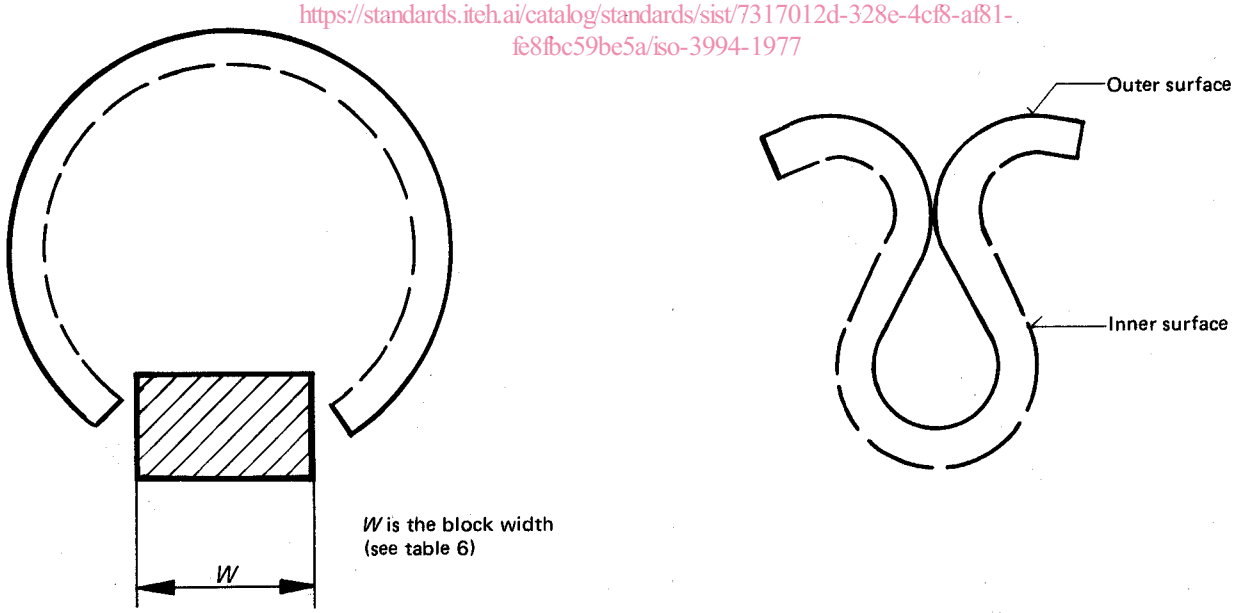

FIGURE 3 – **Diagrammatic representation of reinforcement fracture test**